Third United Nations International Conference on the Peaceful Uses of Atomic Energy

A/CONF.28/A/544
CZECHOSLOVAKIA
February 1964
Original: ENGLISH

Confidential until official release during Conference

Abstract

METALLURGICAL ASPECTS OF ELECTROSLAG WELDING OF REACTOR VESSEL STEELS

J. Zeke

Thesis of a paper for the Third International United Nations Conference on the Peaceful Uses of Atomic Energy.

1. One of the main problems connected with the construction of nuclear power plant equipment is the production of reactor pressure vessels, their main parameters and geometric size being very important for their production.

In order to secure high quality plates for these pressure vessels, the necessary materials are made of relatively small ingots; this is why the single parts of the pressure vessel are made of more components.

Considering the plate thickness, it is most economical to make the single vessel components using electroslag welding.

2. The resulting mechanical as well as structural properties of electroslag welded joints are conditioned not only by the base metal type, but also by three main metallurgical factors characterized as follows:

(a) by the way of physico-chemical processes between the air medium and the slag pool as well as between the slag pool and the liquid weld metal;

(b) by the final primary weld metal structure;

(c) by the susceptibility of the base metal to grain coarsening in the heat affected zone of the welded joint.

3. The said metallurgical factors along with the base metal type characterize also the susceptibility of the welded joint to nitrogen aging which was confirmed by mechanical tests on welds after various heat treatment and detailed structural analysis.

4. To eliminate the influence of aging on the mechanical properties of welded joints and particularly on the transition temperature of the characteristic weld zones, it is necessary on the basis of well known structural and chemical changes in the base material and weld metal to choose especially suitable steels and filler materials for electroslag welding (welding flux and wire).

5. Good results were achieved using Mo alloyed and Al and Ti desoxidized base metal, this being welded with a specially developed flux and welding wire with a small quantity of V added.

6. The stability of electroslag welded joint from the standpoint of nitrogen aging was confirmed by aging tests and structural analysis of the welded joint. Recommendations for the choice of base metals, filler materials, suitable welding regimes and principal heat treatment of electroslag welded joints.